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## Two New *Trechiana* (Coleoptera, Trechinae) from Eastern Shikoku, Japan

By

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*Trechiana* is one of the most important trechine genera in the Japanese Islands. Its members are widely distributed in Honshu and occur also in the Yûbari-Hidaka Mountains of Hokkaido. They are, however, rare and much localized in the southwestern main islands: in Kyushu, only one species, *T. nakaoi*, reaches its northeastern corner (UÉNO, 1972), and in Shikoku, only two species have so far been recorded from its eastern part. Of the latter two, one, *T. chikaichii*, is known from the high altitude of Mt. Tsurugi-san (UÉNO, 1957, pp. 179–184), while the other has not been properly described.

This undescribed species is known on a single female specimen, obtained by Mr. Niichirou KAWANO from a debris of inundation on the bank of the Akui-gawa River and recorded by SHIBATA (1960, p. 70) as *Trechiana* sp. The specimen was later submitted to me for study through the courtesy of Mr. Taichi SHIBATA and proved to belong to a new species. Since then, repeated searches for its natural habitats, both on the surface and in abandoned mines, have been made in the Akui-gawa drainage, but all the efforts have not been repaid up to the present. For this reason, I have not yet given it a scientific name.

On the other hand, the third species of this genus was discovered by Mr. Masaaki SATOU in the autumn of 1972 at the central part of the Sanuki Hills (also called the Asan Hills), and was made known to me through the courtesy of Mr. Masataka YOSHIDA. This discovery was most interesting, since no flightless trechines had theretofore been known from the northern side of the Yoshino-gawa Valley. Unfortunately, male specimens were not included in Mr. SATOU's collection, and we have had to make further fruitless efforts to obtain additional material.

However, Mr. SATOU's enthusiasm brought forth a very good success two years later. At the northern side of Daisen-zan about 14.5 km to the west of the first locality, he discovered, in the autumn of 1974, a habitat of a *Trechiana* which is probably conspecific with his previous specimens, and succeeded in taking a fairly long series of material. This new collection enabled me to deal with the Shikoku species of the genus on a sounder basis. In the present paper, I am going to describe the two new species based upon the material obtained by Messrs. SATOU and KAWANO.

The abbreviations used in this article are as follows: HW — greatest width of head; PW — greatest width of pronotum; PL — length of pronotum, measured along

the mid-line; PA — width of pronotal apex; PB — width of pronotal base; EW — greatest width of elytra; EL — greatest length of elytra; M — arithmetic mean.

I wish herewith to express my hearty thanks to the following persons, whose friendly aids at last led me to complete the present paper: Messrs. Niichirou KAWANO, Tetsuo KAWASAWA, Morisato KIUCHI, Masaaki SATOU, Taichi SHIBATA and Masataka YOSHIDA.

*Trechiana* (s. str.) *satoui* S. UÉNO, sp. nov.

(Figs. 1–3)

Length: 5.1–5.9 mm (from apical margin of clypeus to apices of elytra).

Belonging to the group of *T. oni* and probably closest to *T. fujitai* S. UÉNO (1969, p. 779, fig. 1) of Funakoshi-yama at the eastern part of the Chûgoku Hills. Readily distinguished from that species by the presence of pronotal postangular setae, less oval and less convex elytra, having more salient shoulders, broader and more evidently depressed basal area, deeper striae and more posteriorly situated dorsal pores, elongate flattened aedeagus with narrowly projecting apical lobe, and the horseshoe-shaped proximal group of large teeth inside the inner sac.

Colour as in *T. fujitai*. Head somewhat narrower than in the latter species and with less transverse labrum, though otherwise very similar; antennae reaching apical three-sevenths of elytra or extending a little beyond that level. Pronotum generally similar to that in *T. fujitai*, but a little less transverse on an average and less contracted posteriorly, with more salient front angles, less emarginate base and less acute hind angles; PW/HW 1.43–1.52 (M 1.46), PW/PL 1.02–1.12 (M 1.07), PW/PA 1.41–1.53 (M 1.47), PW/PB 1.36–1.49 (M 1.43); surface less convex than in *T. fujitai* and more or less depressed on the disk, with vague transverse striations; sides moderately arcuate in front, with the widest part at about two-thirds from base or a little before that level, sharply sinuate at a level between one-fifth and one-fourth from base, and then nearly subparallel or slightly divergent towards hind angles, which are more or less sharp but neither very acute nor much produced latero-caudad; both lateral and postangular setae present, the latter being distant from the angle; front angles relatively narrow and more or less advanced; base either nearly straight or shallowly emarginate or slightly bisinuate according to individuals, usually somewhat wider than apex but sometimes as wide, PB/PA 0.99–1.13 (M 1.03); other features as in *T. fujitai*.

Elytra ovate, usually widest at about four-ninths from base, and evidently less convex than those in *T. fujitai*; EW/PW 1.70–1.82 (M 1.75), EL/EW 1.46–1.54 (M 1.50); surface more or less depressed on the disk and in basal area; shoulders distinct though rounded, with prehumeral borders much less oblique than in *T. fujitai*; sides gently arcuate from behind shoulders to near preapical emargination, evidently less rounded than in *T. fujitai*, slightly but distinctly emarginate before apices, which are almost conjointly rounded; striae entire and crenulate, moderately impressed on the disk but becoming shallower at the side, striae 1–5 more or less deepening near base,

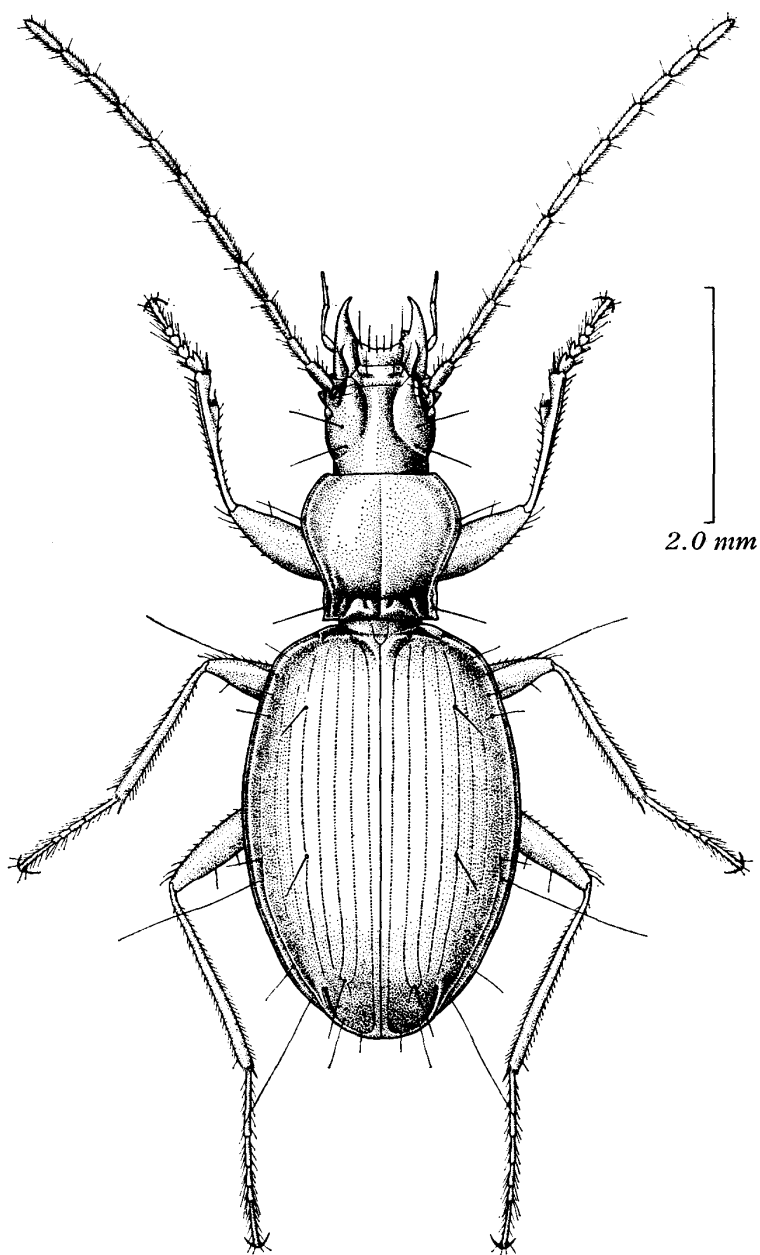
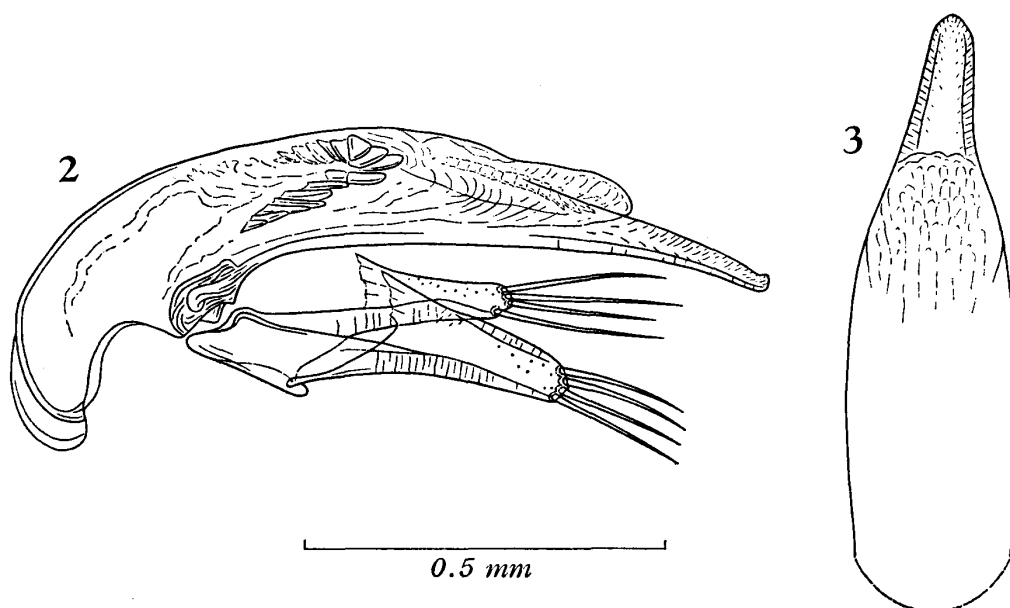


Fig. 1. *Trechiana* (s. str.) *satoui* S. UÉNO, sp. nov., ♂, of Mt. Daisen-zan in the Sanuki Hills.

8 deeply impressed in apical half; scutellar stria distinct though not long; apical stria short but deep, moderately curved, joining or nearly joining stria 5; intervals smooth, slightly convex near suture but flat at the side; apical carina prominent; stria 3 without dorsal pores, preapical pore situated at the apical anastomosis of striae 2 and 3, much more distant from apex than from suture, and more or less closer to apical stria than to suture; stria 5 with two setiferous dorsal pores at  $1/6-2/9$  and  $5/9-3/5$  (usually  $4/7$ ) from base respectively, the anterior pore being behind the level



Figs. 2-3. *Trechiamma* (s. str.) *satoui* S. UENO, sp. nov., of Mt. Daisen-zan in the Sanuki Hills. — 2. Male genitalia, left lateral view. — 3. Apical part of aedeagus, dorsal view.

of the third pore of the marginal umbilicate series; microsculpture as in *T. fujitai*.

Ventral surface and legs as in *T. fujitai*, though the legs are somewhat slenderer than in the latter species.

Male genitalia relatively small though heavily sclerotized, markedly differing in shape from those of *T. fujitai*. Aedeagus about three-tenths as long as elytra, elongate, more or less flattened, especially in apical half, and hardly arcuate at middle, with large basal part which is only gently curved towards the ventral side; basal orifice large, semicircularly emarginate at the sides; sagittal aileron moderately developed, though thin and hyaline; viewed laterally, apical lobe more or less curved ventrad, long and very narrow, gradually tapering towards the extremity, which is blunt and slightly turned up; viewed dorsally apical part projecting into an elongate lobe, which is slightly inclined to the left and ends in a subtriangular tip; ventral side nearly straight at middle in profile. Inner sac armed with two groups of heavily sclerotized teeth but devoid of differentiated copulatory piece; the proximal group horseshoe-shaped, consisting of very large teeth and lying at the left side just before the middle of aedeagus; the apical group composed of linearly ranged, smaller teeth and situated at the right side just inside apical orifice. Styles large but not so long, left style much broader and longer than the right, each normally provided with four apical setae; a fifth seta sometimes present on one style.

*Type-series.* Holotype: ♂, allotype: ♀ (22-IX-1974, M. SATOU leg.). Paratypes: 4 ♂♂, 4 ♀♀ (22-IX-1974, M. SATOU leg.); 6 ♂♂ (10-X-1974, M. SATOU leg.). All deposited in the collection of the National Science Museum (Nat. Hist.), Tokyo.

*Type-locality.* Mt. Daisen-zan, 880-900 m alt., Kotonami-chô, at the central

part of the Sanuki Hills, in Kagawa Prefecture of northeastern Shikoku, Japan.

*Further specimens examined.* 2 ♀♀, Besshi, 460 m alt., Shionoé-chô, Kagawa Pref., 10-X-1972, M. SATOU leg. (in coll. Natn. Sci. Mus. (Nat. Hist.), Tokyo).

*Notes.* The type material of this new species was found in a broad-leaved forest at the northern side of Mt. Daisen-zan (1,043 m in height). In the autumn of 1974, a new road was under construction through the forest, and a ditch was cut at its side. Many of the trechine beetles were taken from beneath rubble and dead leaves accumulating at the bottom of that ditch. Some specimens were also found under stones in a nearby ravine, which might be the original habitat of the insect.

The Besshi specimens were met with in a concreted ditch at the back of a primary school, built on the right bank of the Kodé-gawa River. This place is situated at the western side of Mt. Ohtaki-san (946 m in height) of the Sanuki Hills, and is about 14.5 km distant to the east from Mt. Daisen-zan. Accompanied by Messrs. SATOU and YOSHIDA, I myself paid a visit to the locality in the spring of 1973, and carefully searched for natural habitats of the trechine beetle along the valley of the Kodé-gawa. Unfortunately, all our efforts were in vain to obtain additional specimens, especially males. However, as no appreciable external difference is observed between the Daisen-zan and Besshi specimens, it can be safely concluded that they are identical at least at the species level. When other localities of the beetle are discovered in the intervening part of the Sanuki Hills, possibly at Ryû-ô-zan or Kasagata-yama, we shall be able to deal with the geographical variation of the species in more detail.

It was most unexpected that a species belonging to the group of *T. oni* was discovered in the Sanuki Hills of the Island of Shikoku. All the other members of this species-group have been known from the central and eastern parts of the Chûgoku Hills in western Honshu. Moreover, the two known localities of *T. satoui* are much nearer to the type-locality of *T. chikaichii* than to those of its relatives, the former (Mt. Tsurugi-san) being about 32 km distant to the south-southeast from Mt. Daisen-zan and about 29 km to the south from Besshi. It is true that Mt. Tsurugi-san belongs to the Shikoku Mountains, separated from the Sanukis by the deep valley of the Yoshino-gawa River. However, the Sanuki Hills are isolated from the Chûgokus by the Inland Sea of Seto-naikai, which is much wider than the Yoshino-gawa Valley and forms a barrier apparently more difficult to cross than the latter. This poses an interesting problem for the derivation of *T. satoui*, which must have had a close relationship with past topography. I will come to this subject again on later pages.

*Trechiana (Pseudotrechiana) kawanoi* S. UÉNO, sp. nov.

*Trechiana* sp.: SHIBATA, 1960, Ent. Rev. Japan, Osaka, 11, p. 70.

Length: 5.7 mm (from apical margin of clypeus to apices of elytra).

Closely allied to *T. chikaichii* S. UÉNO (1957, p. 179, figs. 2-3) of Mt. Tsurugi-san, but the body is smaller in size, the prothorax is larger, having wider apex and narrower base, and the elytra are more elongate and have a setiferous dorsal pore on the third

stria before the middle.

Somewhat narrower and more parallel-sided in facies than *T. chikaichii*. Colour light reddish brown, paler than in the latter species, shiny, with iridescent elytra; palpi, scape and apical segments of antennae, ventral side and legs more or less lighter than the dorsal side of body.

Head a little narrower than in *T. chikaichii* though otherwise similar; antennae slenderer, reaching apical two-fifths of elytra, with segment 2 four-sevenths as long as segment 3, which is equal in length to segment 4, segments 7–9 cylindrical, each about two-ninths as wide as long, terminal segment longer than scape but shorter than segment 3. Pronotum cordate, widest at about seven-tenths from base, and much more strongly contracted posteriad than in *T. chikaichii*, with the sides more strongly and narrowly rounded in front, more widely sinuate at about one-fifth from base, and gently divergent again towards hind angles; PW/HW 1.54 (1.47–1.50 in *T. chikaichii*), PW/PL 1.04 (0.98–1.01 in *T. chikaichii*), PW/PA 1.46 (1.51–1.57, M 1.55, in *T. chikaichii*), PW/PB 1.55 (1.39–1.42 in *T. chikaichii*); both lateral and postangular setae present as in *T. chikaichii*; apex wider than base, PB/PA 0.94 (1.09–1.10 in *T. chikaichii*), with front angles slightly more advanced than in *T. chikaichii*; base slightly arcuate though nearly straight at the median part; hind angles sharp, projecting postero-caudad; surface less convex than in *T. chikaichii*, though bearing a similar sculpture. Elytra a little more elongate and less convex than in *T. chikaichii*, widest at about middle, and equally contracted towards the two ends; EW/PW 1.62 (1.66–1.74, M 1.71, in *T. chikaichii*), EL/EW 1.61 (1.55–1.58, M 1.56, in *T. chikaichii*); shoulders as in *T. chikaichii*, with prehumeral borders similarly very oblique; sides a little less arcuate than in *T. chikaichii*, with the preapical emargination very slight; striation as in *T. chikaichii*, though the scutellar stria is absent; stria 3 with a single setiferous dorsal pore at 3/7 from base; preapical pore situated at the apical anastomosis of striae 2 and 3, and close to apex though evidently more distant from apex than from suture; stria 5 with two setiferous dorsal pores at 2/13 and 3/5 from base respectively.

Microsculpture and ventral side as in *T. chikaichii*. Legs slenderer than but structurally similar to those of *T. chikaichii*.

Male unknown.

*Type-specimen.* Holotype: ♀ (27-IX-1959, N. KAWANO leg.). Preserved in the collection of the National Science Museum (Nat. Hist.), Tokyo.

*Type-locality.* Akui-gawa River by Kamiakui, in Tokushima City, near the eastern coast of Shikoku, Japan.

*Notes.* The single known specimen of this new species was found on the bank of the Akui-gawa River about 43 km to the northeast of the type-locality of *T. chikaichii*. The collecting site is in the alluvial plain of the Yoshino-gawa Valley about 11 km distant from the estuary. It is, therefore, apparent that the natural habitat of the trechine lies somewhere along the upper streams of the Akui-gawa River, and that the specimen must have been carried down to that spot by a previous flood. The river is by no means large, and its drainage is only 30 km long and 5–10 km wide.

However, it is not easy to locate the original habitat even within the limited area. With the aid of Messrs. KAWASAWA, KIUCHI and YOSHIDA, I have looked for it for a long time, but have so far been unable to get a good result. Nevertheless, the discovery of *T. kawanoi* is important for the analysis of the trechine fauna of Shikoku, as this is a positive proof that the distributional range of the group of *T. chikaichii* extends eastwards on the eastern part of the Shikoku Mountains or along the southern side of the Yoshino-gawa Valley.

### Discussion

The Island of Shikoku is the smallest of the four main islands of Japan, but is the richest in the subterranean fauna. As regards anophthalmic trechine beetles, about forty species (including about ten undescribed ones of the genera *Ishikawatrechus* and *Yamautidius*) distributed to eight different genera have hitherto been found there. Of the eight genera, six are confined in small areas of Shikoku, while the remaining two, *Rakantrechus* and *Trechiana*, are much more widespread in the neighbouring islands. *Rakantrechus* is distributed throughout central Kyushu, but is represented in Shikoku by only a single small species occurring in two caves at the western part. *Trechiana*, on the other hand, spreads almost all over Honshu, but reaches only the northeastern part of Shikoku, where its distribution partially overlaps that of *Awatrechus*. Thus, *Trechiana* is by no means a predominant group in this island.

Up to the present, three species of *Trechiana* have been known in Shikoku. The species first discovered is *T. chikaichii* inhabiting the subalpine forest at the northern side of Mt. Tsurugi-san. It is primarily endogean, though an individual was also met with in a cave. The second species, *T. kawanoi*, is known at present only on a female, but is no doubt close to the Tsurugi-san species. They together form a compact group rather isolated within the genus, and are considered to have been derived from a common ancestor, which had colonized the eastern part of the Shikoku Mountains from somewhere in Honshu.

The species-group that seems to have a direct relationship with the two Shikoku species is that of *T. habei*, whose distributional range stretches along the Pacific coast of central Honshu from the eastern part of the Kii Peninsula to the southern part of the Kwantô Mountains, with two isolated populations, one at the northern part of the Abukuma Hills and the other at the northern part of the Kushigata Hills (cf. UÉNO, 1974, pp. 105–112). No representatives of the genus have been known from the western part of the Kii Peninsula. It is, however, possible that certain endogean forms exist there, especially at high altitudes, and if such species are brought to light, they should prove to belong to the group of *T. habei*. In any case, the common ancestor of *T. chikaichii* and *T. kawanoi* seems to have come from the Kii Peninsula during the Pleistocene. As the two species show a definite affinity with the trechines found in the eastern part of the Kii Peninsula, the immigration of their ancestor cannot

have taken place at a very old time. On the other hand, the distinct gap between the Shikoku and Kii species and the fact that the speciation of the two species must have occurred in the Shikoku Mountains suggest that the segregation of the ancestral trechine was accomplished before the last transgression in the Pleistocene. It is, therefore, possible that the ancestral trechine invaded Shikoku on land in the Third Glacial Period. However, there still remains a possibility that the invasion was made across the Kii Channel, probably on a drift of vegetable debris produced by inundation. This is suggested by the fact that the range of *T. chikaichii* and *T. kawanoi* is narrowly limited at the eastern part of the Shikoku Mountains.

In contrast to the two species discussed above, the third species, *T. satoui*, has its origin in the north. It belongs to the group of *T. oni*, of which all the four species previously described are confined in the central and eastern parts of the Chûgoku Hills. The species-group itself is considered to have been yielded from the group of *T. ohshimai* by losing a series (usually the internal series) of setiferous dorsal pores on elytra (cf. UÉNO, 1959, pp. 29–30). The latter species-group occupies an area adjoining to the east of that occupied by the group of *T. oni*, and together with this, spreads from east to west in western Honshu. None of the species of these groups have dispersed southwards into the Kii Peninsula, so that the ancestor of *T. satoui* does not seem to have come from that direction. Somehow it must have crossed the Inland Sea of Seto-naikai directly from the Chûgoku District, either on land or over the sea. Here arises a difficult problem. In the early Pleistocene, the inland sea was a large lake, which was wider than the existing sea, and the northeastern part of Shikoku was largely under the water. Later, this lake was connected with the Pacific by the subsidence of the Kii Channel, which separated Shikoku from the Kii Peninsula. The upheaval of the Sanuki Hills is said to have begun at an early stage of the Middle Pleistocene, but there is no geological evidence that the hills extended northwards across the inland sea area. During the subsequent glacial periods, shorelines retreated extensively according to eustatic movements of the sea, but the inland sea area always remained a lowland.

As can be seen from the foregoing description, there is no distinct taxonomic gap between *T. satoui* and the Chûgoku species of the group of *T. oni*. This seems to indicate that the ancestor of the former became already anophthalmic and adapted to endogean habitats when it immigrated from Chûgoku to the Sanuki Hills. Such anophthalmic forms never dwell in lowlands; they may occur near the sea-level where hilly areas meet the sea, but never penetrate deep into plains. It is, therefore, not plausible that the ancestral trechine crossed the inland sea area when it was dried up. In all probability, the dispersal must have been accomplished across the sea through the agency of floods of large rivers, when the inland sea was narrower than it is at present. This perhaps took place during the Last Glacial Period; otherwise the species might have become differentiated to a greater extent.

In short, the Shikoku species of *Trechiana* are distinguished into two groups of different origin. One of them comprises *T. chikaichii* and *T. kawanoi*, and is doubt-



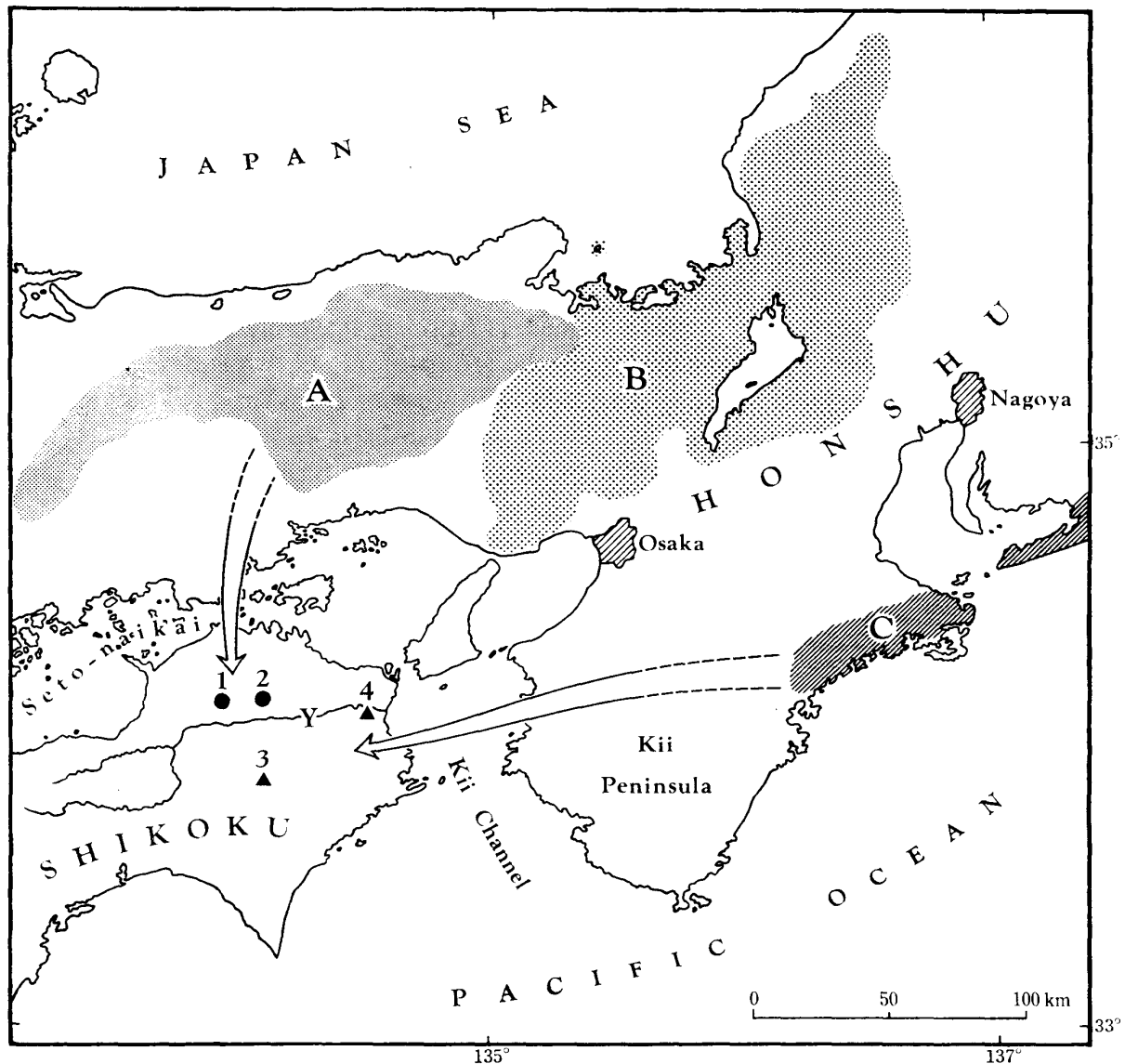


Fig. 4. Map showing the distribution of *Trechiana* in the Island of Shikoku and its neighbouring areas. Fine dots (A) indicate the distributional range of the group of *T. oni* in the Chûgoku Hills; coarse dots (B) indicate that of the group of *T. ohshimai*; diagonal hatching (C) shows the western part of the distributional range of the group of *T. habeii*. Y: Yoshino-gawa River. — 1, Mt. Daisen-zan (*T. (s. str.) satoui* S. UÉNO, sp. nov.); 2, Besshi (*T. (s. str.) satoui* S. UÉNO, sp. nov.); 3, Mt. Tsurugi-san (*T. (Pseudotrechiana) chikaichii* S. UÉNO); 4, Kamiakui (*T. (P.) kawanoi* S. UÉNO, sp. nov.).

less older than the other. Their ancestor seems to have come from the Kii Peninsula and successfully colonized the eastern part of the Shikoku Mountains. The other group includes only one species, *T. satoui*, which seems to have been derived from an ancestral trechine that had invaded the Sanuki Hills from Chûgoku at rather a recent time. It is not easy to elucidate why the Yoshino-gawa Valley that separates the

Sanuki Hills from the Shikoku Mountains has constituted such an effective barrier against the dispersal of the *Trechiana* species. However, this can be regarded as a proof that the ancestors of these endemic species became already anophthalmic and could not actively disperse when they reached the Island of Shikoku.

### Summary

*Trechiana chikaichii* is the only species of the genus hitherto described from the Island of Shikoku. Two more anophthalmic species of the same genus are newly reported in this paper. One of them, named *T. kawanoi*, is closely allied to *T. chikaichii*, while the other, *T. satoui*, belongs to the group of *T. oni*, whose members were previously known only from the Chûgoku Hills in western Honshu. The two species, *T. chikaichii* and *T. kawanoi*, are considered to have been derived from a common ancestor that had immigrated into the eastern part of the Shikoku Mountains from the Kii Peninsula. The third species, *T. satoui*, must have reached the Sanuki Hills from the north across the Inland Sea of Seto-naikai. Thus, the three *Trechiana* species now known in the Island of Shikoku are classified into two groups of different origin and history.

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